Preventing and Treating Osteoporosis: Healthy Bones At All Ages

Deborah E. Sellmeyer, MD

Assistant Professor, Division of Endocrinology

Director, UCSF/Mt. Zion Osteoporosis Center

Osteoporosis Facts

- Bone is normal, but reduced in amount
- Lifetime risk of wrist, hip, spine fracture
  - 40% Caucasian women
  - 14% Caucasian men
  - Other ethnic backgrounds ~1/3-1/4 rates in Caucasians
- Osteoporosis has no symptoms: 80% undiagnosed

Peak Bone Mass

- Bone density=peak bone mass-bone loss
- Peak bone mass
  - Genetics
  - Gender
  - Race
  - Gonadal steroids (estrogen, testosterone)
  - Timing of puberty
  - Calcium intake
  - Exercise

Adult Bone Loss

- Bone density fairly stable in 30's and 40's
- Menopause:
  - Bone loss accelerates first 5 yrs
  - Spine more sensitive than hip
- With aging:
  - More balanced loss
  - Both men and women

Causes of Increased Adult Bone Loss

- Estrogen or testosterone deficiency
- Endocrine: ↑ thyroid, ↑ parathyroid, ↑ cortisol, ↓ growth hormone, ↓ vitamin D
- Malabsorption, liver, kidney disease
- Medications
  - Anti-inflammation steroids: prednisone
  - Blood thinners
  - Anti-seizure medications
  - Immune suppressive medications
  - Excessive thyroid hormone

Pre-menopausal Factors

- Oral contraceptives
  - No effect or possibly a beneficial effect
- Pregnancy
  - Very few studies
  - Number of children not related to fracture
- Lactation
  - May be some bone loss during nursing
  - Typically recovery after weaning

Risk Factors for Osteoporosis

- Caucasian race
- Female
- Fracture as an adult
- First degree relative with a fracture
- Current tobacco use
- Low body weight (<127 lbs)
- Lifelong low calcium intake
- Vitamin D deficiency
- Inadequate physical activity
- Early estrogen loss
  - menopause before age 45
  - surgical removal of ovaries
  - prolonged lack of menstrual cycles
- Low testosterone in men
- Dementia
- Alcoholism
- Advanced age

How do you know if you have osteoporosis?

- No symptoms until fracture
- Vertebral
  - sudden onset pain with minimal movement
  - can occur without pain
  - ↑ risk future fractures and mortality
- Wrist
- Hip
  - usually associated with fall
  - mortality: 15-20%
  - morbidity: 30% require nursing home

Diagnosis—Bone Mineral Density

- Site-specific measurement best
- Diagnostic criteria developed using DXA
- T-score = comparison to peak bone mass
- Z-score = comparison to age matched bone mass
- Decrease of 1 unit in T-score =doubling of fracture risk

T-score = -1 ⟶ Fracture risk 2X

T-score = -2 ⟶ Fracture risk 4X

Measuring Bone Density

- DXA
  - Very precise
  - Low radiation
  - Rapid scanning
  - Lower cost
  - Not as sensitive for spine with extensive arthritis
- Ultrasound
  - Cheap
  - No radiation
  - Possible use as screening tool

Diagnosis by DXA

- WHO definition
  - Normal: T-score greater than - 1
  - Osteopenia: T-score - 1 to - 2.5
  - Osteoporosis: T-score - 2.5 or greater
- Continuous relationship, not threshold
- Data primarily from postmenopausal white women

Who to Scan?

- National Osteoporosis Foundation
  - All women over age 65
  - Postmenopausal women < 65 yrs with one or more risk factors
  - Postmenopausal women with fractures
- Risk factors: Caucasian race, low weight, alcohol, tobacco, hx adult fx, +FH osteoporosis, medications, low Ca intake

Prevention and Treatment

- Prevention is for everyone
- Treatment
  - National Osteoporosis Foundation guidelines
    - T-score < -1.5 with one or more risk factors
    - T-score < -2 regardless of risk factors
    - Older women (> 70 years) with multiple risk factors may not need DXA
  - Guidelines, not absolutes
  - Data from postmenopausal white women

Prevention and Therapy Options

- Nutrition
  - Calcium
  - Vitamin D
  - Protein
  - Salt
- Exercise
- Alcohol
- Tobacco
- Medications

Calcium

- Dairy free diet = 300-400 mg calcium
- Lifelong low calcium diet--risk factor for osteoporosis
- Older men and women--prevents bone loss, reduces fractures 50% when given with vitamin D
- Current recommendations
  - up to age 50: 1000 mg/day
  - ages 51+: 1200-1500 mg/day
  - maximum: 2500 mg/day
- Labels based on 1000 mg

  3% = 30 mg

  25% = 250 mg

Sources of Calcium

- Dairy foods
- Lactose intolerance
  - Hard cheeses (parmesan)
  - Fortified cereal
  - Fortified OJ and other juices
  - Tofu
  - Fruit/grain bars
  - Lactase treated products
- Dark green leafy vegetables
- http://www.nal.usda.gov/fnic/cgi-bin/nut_search.pl
- Supplements

Vitamin D

- 50% of elderly patients with hip fx vitamin D deficient
- 67% of patients > age 65 admitted to hospital vitamin D deficient
- 800 IU/day reduced hip fractures in elderly nursing home residents
- Current recommendations:
  - up to age 50: 200 IU/day
  - ages 51-70: 400 IU/day
  - ages 71+: 600 IU/day
  - maximum: 2000 IU/day

Sources of vitamin D

- Sunshine: 20 minutes/day
- Multivitamin: 200-400 IU
- Milk 100 IU/glass
- Cod liver oil: 453 IU/teaspoon
- Sardines: 33 IU/sardine
- Tuna in fish oil: 170 IU/ 1/2 cup
- Egg: 26 IU/large egg

Dietary Protein and Bone: Acid-Base

- Protein important for peak bone mass, preventing bone loss, fracture healing
- Animal vs Vegetable
  - acid: metabolism of protein
  - base: neutralizes acid, comes from fruit/vegetables
  - bone contains base--broken down to neutralize high acid, low base diet?
- Maintain adequate protein intake, increase intake of fruit and vegetables

Dietary Protein and Bone: Dairy and Soy

- Dairy
  - Unknown effects on acid-base
  - Good source of calcium and protein
  - Fortified with vitamin D
- Soy
  - Some soy products contain isoflavones
  - Best sources: edamame, soybeans, tempeh, full fat tofu
  - Food sources may be better than protein powders

Dietary Salt Intake

- Increasing dietary salt increases urine calcium
- High salt diets may increase bone breakdown
- Effects on fracture not known
- Increased dietary base (fruit and vegetables) may offset salt effects
- High salt foods:
  - prepared foods--jars, cans, boxes, bottles
  - condiments, sauces
  - cheese, bread

Diet Summary

- Calcium: 1000-1500 mg/day
- Vitamin D: 400-800 IU/day
- Protein--keep protein intake normal, start working in more fruit and vegetables
- Consider adding soy to your diet
- Keep salt intake to <3500 mg/day

Exercise

- Weight bearing exercise
- If you have osteoporosis, avoid exercises that curl spine forward
- Check with your doctor before beginning any program

Alcohol and Tobacco

- Keep alcohol intake to moderate use: less than 1 drink/day for women, 2 drinks/day for men
- Stop smoking
  - Can be very difficult
  - Most people stop 3-4 times before quitting for good
  - Talk with your doctor about nicotine patches, gum, and behavior programs

Estrogen

- Early menopause
  - Prevents bone loss (oral or patch)
  - Effective for hot flashes
- Late menopause
  - Increases bone density
  - Decreases fracture risk by 35-40%
- Appropriate duration and risks/benefits still under investigation
  - No benefit for heart disease
  - Increased risk of vascular events and breast cancer

Calcitonin (Miacalcin)

- Early postmenopause
  - Conflicting reports on preventing bone loss
- Late menopause
  - May prevent bone loss with calcium
  - Fracture studies small
- Side effects--flushing, nausea primarily with injectable form and higher doses
- Nasal preferable--100-200 IU qd
- Possible pain relief effect

Bisphosphonates

- Bind to bone, prevent bone breakdown
- Oral:
  - Alendronate (Fosamax)
  - Risedronate (Actonel)
- Bisphosphonate side effects
  - Contraindicated with esophagus or active gastrointestinal disease
  - Take with 6-8 oz water first thing in am
  - Do not lay down or eat for 30 minutes

Bisphosphonates

- Alendronate (10 mg/day)
  - Increases bone density 4%-9%
  - Decreases fracture risk by 50%
- Risedronate (5 mg/day)
  - Bone density increased by 2%-6%
  - Decreased fracture risk by 40%
- Both have weekly regimens that are equally effective

Antiestrogens

- Tamoxifen
  - May help prevent spine bone loss
  - Benefit to women taking it for breast cancer
- Raloxifene (Evista) (60 mg/day)
  - Selective estrogen receptor modulator (SERM)
  - Increased bone density 2%
  - Decreased fracture risk 30-50%
  - Decreased breast CA incidence 76%
  - Side effects--hot flashes, venous thromoembolism

Other therapies

- Hip protectors
  - ↓ hip fractures 60%
- PTH
  - Increase bone density by 9-13% at spine, 3-6% at hip
  - 70% reduction in spine fx's, 55% reduction in non-spine fracture risk
  - 1-34 FDA approved; 1-84 under investigation

Summary

- Skeletal health important at all stages of life
- Lifestyle factors
  - Optimize nutrition
  - No tobacco
  - Alcohol in moderation
  - Physical activity
- Medications